

Claims

- [c1] 1. A method of manufacturing a fin-type field effect transistor (FinFET), said method comprising:
- forming a modified H-shaped structure over a silicon layer structure, wherein said forming of said modified H-shaped structure includes forming alignment marks in said silicon layer structure separate from said modified H-shaped structure;
 - transferring said modified H-shaped structure pattern into a silicon layer of said silicon layer structure, such that a portion of said silicon layer has said modified H-shaped structure that includes two opposing box-shaped structures connected by a fin;
 - forming a gate conductor between said box-shaped structures of said silicon layer, wherein said gate conductor intersects said fin, and wherein said process of forming said gate conductor aligns said gate conductor with said modified H-shaped structure using said alignment marks;
 - forming a gate sidewall spacer on said gate conductor, wherein said gate sidewall spacer is present only on said gate conductor and is not present on said modified H-shaped structure of said silicon layer; and
 - growing additional silicon on said modified H-shaped structure of said silicon layer.
- [c2] 2. The method in claim 1, wherein said process of forming said modified H-shaped structure comprises:
- forming mandrels on said silicon layer structure;
 - forming sidewall spacers around said mandrels;
 - removing said mandrels and leaving said sidewall spacers in place;
 - removing portions said sidewall spacers; and
 - forming masks over portions of said sidewall spacers, such that a

remaining sidewall spacer connects said masks and creates said modified H-shaped structure.

[c3] 3. The method in claim 2, wherein said remaining spacer is perpendicular to said opposing sidewall spacers.

[c4] 4. The method in claim 1, further comprising, after said process of growing said additional silicon, implanting impurities into said modified H-shaped structure of said silicon layer

[c5] 5. The method in claim 1, further comprising, before forming said gate conductor:
growing a sacrificial oxide on said modified H-shaped structure of said silicon layer;
implanting impurities into said fin and said box-shaped structures of said silicon layer; and
removing said sacrificial oxide.

[c6] 6. The method in claim 1, further comprising, before forming said gate conductor, forming a gate insulator over said fin of said silicon layer.

[c7] 7. The method in claim 1, wherein, in said modified H-shaped structure, said fin is not centered along the lengths of said opposing box-shaped structures.

[c8] 8. A method of manufacturing a fin-type field effect transistor (FinFET), said method comprising:
forming a modified H-shaped structure over a laminate structure, wherein said laminate structure comprises a substrate, a silicon layer above said substrate, and a hard mask above said silicon layer, and wherein said process of forming said modified H-shaped structure includes forming

alignment marks in said laminate structure separate from said modified H-shaped structure;

transferring said modified H-shaped structure pattern into said hard mask;

removing said modified H-shaped structure;

using said hard mask to transfer said modified H-shaped structure pattern into said silicon layer, such that a portion of said silicon layer has said modified H-shaped structure that includes two opposing box-shaped structures connected by a fin;

forming a gate conductor between said box-shaped structures of said silicon layer, wherein said gate conductor intersects said fin, and wherein said process of forming said gate conductor aligns said gate conductor with said modified H-shaped structure using said alignment marks;

forming a gate sidewall spacer on said gate conductor, wherein said gate sidewall spacer is present only on said gate conductor and is not present on said modified H-shaped structure of said silicon layer; and

growing additional silicon on said modified H-shaped structure of said silicon layer.

- [c9] 9. The method in claim 8, wherein said process of forming said modified H-shaped structure comprises:
- forming a mandrel on said hard mask;
- forming sidewall spacers around said mandrel;
- removing said mandrel and leaving said sidewall spacers in place;
- removing one segment of said sidewall spacers; and
- forming box-shaped structures over opposing sidewall spacers that remain after removing said one segment of said sidewall spacers, such that a remaining sidewall spacer connects said box-shaped structures and creates said modified H-shaped structure.

- [c10] 10. The method in claim 9, wherein said remaining spacer is perpendicular to said opposing sidewall spacers.
- [c11] 11. The method in claim 8, further comprising, after said process of growing said additional silicon, implanting impurities into said modified H-shaped structure of said silicon layer
- [c12] 12. The method in claim 8, further comprising, before forming said gate conductor:
growing a sacrificial oxide on said modified H-shaped structure of said silicon layer;
implanting impurities into said fin and said box-shaped structures of said silicon layer; and
removing said sacrificial oxide.
- [c13] 13. The method in claim 8, further comprising, before forming said gate conductor, forming a gate oxide over said fin of said silicon layer.
- [c14] 14. The method in claim 8, wherein, in said modified H-shaped structure, said fin is not centered along the lengths of said opposing box-shaped structures.
- [c15] 15. A method of manufacturing a fin-type field effect transistor (FinFET), said method comprising:
forming a mandrel over a laminate structure, wherein said laminate structure comprises a substrate, a silicon layer above said substrate, and a hard mask above said silicon layer;
forming sidewall spacers around said mandrel;
removing said mandrel and leaving said sidewall spacers in place;
removing one segment of said sidewall spacers;
forming box-shaped structures over opposing sidewall spacers that

remain after removing said one segment of said sidewall spacers, such that a remaining sidewall spacer connects said box-shaped structures and creates a modified H-shaped structure over said hard mask, and wherein said process of forming said box-shaped structures includes forming alignment marks in said laminate structure separate from said modified H-shaped structure;

transferring said modified H-shaped structure pattern into said hard mask;

removing said modified H-shaped structure;

using said hard mask to transfer said modified H-shaped structure pattern into said silicon layer, such that a portion of said silicon layer has said modified H-shaped structure that includes two opposing box-shaped structures connected by a fin;

forming a gate conductor between said box-shaped structures of said silicon layer, wherein said gate conductor intersects said fin, and wherein said process of forming said gate conductor aligns said gate conductor with said modified H-shaped structure using said alignment marks;

forming a gate sidewall spacer on said gate conductor, wherein said gate sidewall spacer is present only on said gate conductor and is not present on said modified H-shaped structure of said silicon layer; and

growing additional silicon on said modified H-shaped structure of said silicon layer.

[c16] 16. The method in claim 15, further comprising, after said process of growing said additional silicon, implanting impurities into said modified H-shaped structure of said silicon layer

[c17] 17. The method in claim 15, further comprising, before forming said gate conductor:

growing a sacrificial oxide on said modified H-shaped structure of said

silicon layer;
implanting impurities into said fin and said box-shaped structures of said silicon layer; and
removing said sacrificial oxide.

[c18] 18. The method in claim 15, further comprising, before forming said gate conductor, forming a gate oxide over said fin of said silicon layer.

[c19] 19. The method and in claim 15, wherein said remaining spacer is perpendicular to said opposing sidewall spacers.

[c20] 20. The method in claim 15, wherein, in said modified H-shaped structure, said fin is not centered along the lengths of said opposing box-shaped structures.